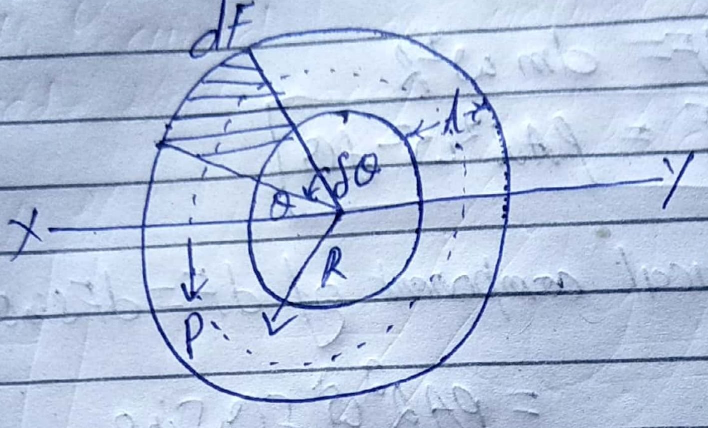
Q.4 Dimensions of flywheel

Answer →



Consider a small element of rim which subtends an angle $\delta\theta$ at the centre of the flywheel

Let, D = Mean diameter of rim

R = Mean radius of rim

A = Cross-sectional area of rim

ρ = Speed of flywheel

ω = Angular velocity of flywheel force

σ = Tensile stress due to centrifugal force

v = Linear velocity at the mean radius

$$= R\omega = \frac{\pi D N}{60}$$

Volume of the small element $= AR\,\delta\theta$

and, mass of the small element.

dm = Density × Volume

$$\boxed{dm = \rho A R\,\delta\theta}$$

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Centrifugal force that acts radially outwards

$$dF = dm\,\omega^2 R$$

$$\boxed{dF = \rho A R^2 \omega^2 \delta\theta}$$

vertical component of $dF = dF \sin\theta$

$$= \rho A R^2 \omega^2 \delta\theta \sin\theta$$

Total vertical upward force tending to burst the rim.

$$F = \rho A R^2 \omega^2 \int_0^{\pi} \sin\theta \, d\theta = 2\rho A R^2 \omega^2 \quad \text{--- (1)}$$

and

$$2P = 2\sigma A \quad \text{--- (2)}$$

on putting eq (1) and (2)

$$2\sigma A = 2\rho A R^2 \omega^2$$

$$\sigma = \rho R^2 \omega^2$$

$$\sigma = \rho R^2 \omega^2$$

$$\sigma = \rho V^2$$

$$V = \sqrt{\frac{\sigma}{\rho}}$$

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The mass of rim, m = Volume × Density ρ

$$= \pi D A \rho \quad \text{---} \ (3)$$

and

$$A = \frac{m}{\pi D \rho} \quad \text{---} \ 4$$

If the cross-sectional area of the rim is rectangular then

$$\boxed{A = bt}$$

b = width of the rim

t = Thickness of the rim

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